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PRACTICAL PROCEDURE IN INFERENCE.

IN the various modes of inference which are actually employed in the practical affairs of everyday experiences, we find many a departure from the traditional syllogistic form. Moreover, the rules of the syllogism are not the usual tests to which we subject our reasoning in order to assure ourselves of its validity. The following considerations will serve to illustrate the common mental habit which in general characterizes the ordinary processes of inference :

1. The usual mode of reasoning suppresses one of the premises, and presents the inference in the form of the so-called Enthymeme. This term is by its very significance misleading, for it implies that the omitted premise is fully expressed in thought, though not in words, whereas it is a question whether the verbal omission does not also indicate a corresponding abbreviation of thought. A strict criticism of the Enthymeme according to syllogistic rules is possible only when the omitted premise is supplied, and the syllogism in full is presented to consciousness for inspection. This, however, is not actually done ; for the shortened form seems to furnish immediate evidence of its validity.

2. A syllogism, although in proper form, nevertheless often contains four or more terms, in violation of the fundamental requirement of three terms only. An additional term may be merely the contradictory of one of the traditional three terms. In such a case the procedure, as provided for by the formal rules of the syllogism, necessitates the changing of the proposition containing the contradictory term into its obverse, so as to effect a corresponding change of the contradictory term itself, so that the syllogism then will contain three terms only. But in actual inference there does not seem to be any necessity for so formal an operation for in most cases ; the considerations which determine validity are sufficiently obvious, and admit direct procedure from the premises to the conclusion. For example in the following syllogism,

All materialists are determinists,
A certain philosopher is an indeterminist,
.·. He is not a materialist,

we have four terms, also two premises affirmative in form giving a negative conclusion. It is, however, not necessary to obvert the minor premise, so as to have it in the negative form: A certain philosopher is not a determinist. The recognized incompatibility of the two terms, materialist and indeterminist, upon the basis of the proposition, All materialists are determinists, of itself necessitates the conclusion, without changing the form of either premise in order to apply the technical rules of the syllogism in respect to the distribution of terms.

There is still another way in which the three term requirement as to syllogistic form may be violated, as is illustrated in the following inference:

The sum of the angles of any triangle equals 180°,
Of a certain triangle the angles *A* and *B* equal 165°,
.·. The remaining angle *C* equals 15°.

Here we have two premises and a conclusion, as in the usual form of the syllogism, but, then, there are six terms. We cannot apply the canon of the affirmative syllogism to this inference, namely: Terms which agree with the same third term agree with each other. There is no term of common agreement, and, therefore, in the strict sense of the word no middle term. There is, however, a quantitative relation between these six terms as definite and as cogent as that which characterizes that fundamental relation of agreement which finds expression in the canons of the syllogism. A term may not agree with another term, but it may be recognized as greater or less than that term by such an exact amount as to form the ground for a necessary and precise conclusion based upon such a relation.

3. A purely formal criticism of the syllogism will often be affected by certain material considerations which should not be overlooked in the endeavor to reach a valid conclusion. We may have, for instance, a syllogism like the following:

All acids turn blue litmus paper red,
A certain compound is observed to turn a piece of blue litmus paper red,
.·. It is an acid.

The above is a case of undistributed middle, and therefore invalid if we regard the form merely. However, we unhesitatingly accept the conclusion as valid, because it is warranted by our knowledge of the material relations involved. We do not assure ourselves of the validity of our inference by observing that the major premise really distributes its predicate in this case and so provides for a distributed middle term. In other words, it is a qualitative and not a quantitative relation between terms which is regarded by us as a practical test of validity. The formal criticism of a syllogism necessitates a comparison of terms as regards their relative positions in propositions, in order to reveal their distribution or non-distribution, and so to detect the fallacies of illicit process and of undistributed middle. My contention is that this formal procedure is departed from, and that a more direct and a simpler method is pursued in actual inference. This method is of such a nature that it preserves the essential features of the syllogism without running the data of inference into syllogistic moulds.

The essentials of inference, as embodied in the syllogistic structure, are, as is well known, an identical point of reference, and also the presence of some universal relation. The identical point of reference, however, need not be indicated by a middle term expressed in full form in two propositions, which stand as major and minor premises. It may be that the two terms which are brought into comparison are seen merely to lie within one and the same system, and that their relation to a common point of reference is not necessarily one of simple agreement, but is of such a definite nature as to be immediately apprehended with certainty and conclusiveness. For example, when we have two angles of a triangle given, and we infer the third, we recognize the relations which obtain in the one system, whose coördinated elements are determined by the necessities of triangular construction ; the system, in this case, is to be regarded as the identical point of reference. Again, the universal which must underlie all valid inference need not be expressed in a major premise. It may not even be explicit in our consciousness. By long experience, or by significant experiments, there may have been established in the mind so indissoluble a connection between a subject and its characteristic predicate, and this connection may have become so familiar as to need no expression in unusual form. In the process of forming this connection through induction, its universal aspect has been fully emphasized once for all, and, consequently, between the subject and predicate there has been manifested such a constant association that the one is regarded as implying the other directly and simply by virtue of the very integrity of its fundamental concept, or, as we may express it in another way, the attributes of the two concepts have fused one with the other. This fusion, this universal association, does not need repeated expression in a proposition whose form will show a properly distributed term. The passage from one to the other of two related terms is so natural and so direct, because through constant association the brain modification corresponding to the one has been in all past experience inseparably connected with the brain modification corresponding to the other. There has been this psychological preparation for an immediate influence, so that whenever one of the constantly related elements is given, its presence in consciousness is regarded as an evident implication that the other must necessarily be forthcoming also.

Now every inferred element of experience is referred to that which seems to be its appropriate place in some particular system of known relations, by virtue of a logical canon which may be called the canon of essential reference. This may be expressed as follows: Every inferred element may be referred to a given system whenever it is recognized that the element in question is essential to the integrity of that system. For, every experience contains two parts, that which is given, *plus* elements which can not be directly cognized, but whose presence and characteristic features are necessarily involved in the given, upon the ground that the phenomena in question have been invariably conjoined in experience with certain constant marks, which, therefore, may be confidently inferred even though they may not be the object of direct observation. If this were not possible, our knowledge regarded as a system would be neither intelligible, self-consistent, nor complete. The one test to which the inferred elements must be subjected is this, that they must in all cases be recognized as fitting with perfect congruence into the system to which we are constrained to refer them. The test, it will be observed, is not quantitative, as is the test respecting the distribution of terms; it is rather qualitative, inasmuch as it raises the question as to the affinity of one term with another, and as to whether one term by its very nature implies the other. This qualitative criterion will be seen to be the one actually followed in our reasoning if we examine the three different modes of inference, to which our thought naturally conforms. The three modes are as follows:

1. There may be given a certain subject, and we infer the marks which necessarily characterize that subject. This is the logic of analysis. In passing, it may be well to note that in the above the term, 'mark' is used to denote either an attribute, a relation, or a function. We may have, for instance, the following inference as an illustration of the passage from a subject to its essential marks. Suppose that for a certain piece of work I affirm that iron is the proper substance to use, because I know that malleability which is a property of iron will greatly facilitate the work in question; in such a statement I infer the presence of an attribute as the direct result of my knowledge of the specific properties of iron. The attribute malleability is recognized as essential to that system whose coördinate elements constitute the concept iron. The above statement of the inference in question is the usual mode of expressing all such inferences rather than the syllogistic form. If we put the same thought in the form of a syllogism, it will appear as follows:

All iron is malleable,
This piece of metal is iron,
∴ It is malleable.

In this form, we unnecessarily amplify the thought processes. Moreover, if we criticise this syllogism in respect to the criterion respecting the distinction of terms, we withdraw attention from that which constitutes the force of the inference, namely, the fact that malleability is an inseparable property of iron, for in the traditional form of criticism we are required to isolate the term iron, and compare its position in the major premise with its position in the minor premise in order to reveal any lurking illicit process. We have, thereby, separated for the time being in thought an inseparable property from its subject. The essential feature of inference, however, is just the opposite of this. It is a fusion of attributes rather than a separation, a synthesis rather than a process of abstraction. This may be seen perhaps in clearer light, if we take a symbolic expression of the syllogistic form :

All x is y,
All z is x,
$\therefore$ All z is y.

In the criticism of such a syllogism we regard x as brought into an external relation to y in a proposition whose form properly distributes x, and therefore renders the conclusion valid. In the mode of reasoning, however, which is usually followed in the ordinary experiences of life, the material considerations enter largely as determining factors, and they emphasize the internal rather than the external relations of subject and object.

(2) That which is given may be a certain mark, or marks, from which we are able to infer the appropriate subject. This is the Logic of Identification. By the presence of certain well defined marks we are able to differentiate the edible from non-edible mushrooms. These marks are recognized, therefore, as diagnostic in character, forming a basis for direct and immediate inference. The inference, in such cases, is often quite reflex, through a constant and familiar association, and we are hardly conscious that it is a veritable inference. There are many inferences of this kind which it is peculiarly difficult to put into a syllogistic form, namely, those which are mediated through the recognition of a collocation of attributes which are implicitly apprehended. Although the subject may be unerringly identified, yet the guiding marks in this identification may be grasped by the mind only under the form of some such indefinite expression as the following: A certain subject is known to us as the function of certain attributes, x, y, z, etc. Therefore, when we see the combination which may be expressed symbolically as $f(x, y, z, \text{etc.})$, we immediately infer the subject which our past experience has taught us must belong to it. The marks, $f(x, y, z, \text{etc.})$, may consti-

tute a system which is merely a visual picture, and, therefore, can not be conceptually but only receptually discerned. Consequently, it may be impossible to give such a combination of attributes any exact expression in definite terms as elements of a syllogism. They sustain, however, such an integral relation to the subject whose essential significance they constitute, as to be regarded by us always and everywhere as clearly indicating it.

(3) We may have given certain marks whose known characteristics suggest others which necessarily grow out of them. This sort of inference is the Logic of Elaboration. The inferred elements are the natural complements of the given, and are, therefore, immediately supplied by a simple transition of thought from one to the other. We may have given, for instance, a fossil tooth. It is observed to possess certain characteristics from which it is inferred that the animal to which that tooth belonged must have been a carnivorous animal. Certain marks which are observed necessitate others which are by nature intimately connected with them. This is especially true of attributes which may be characterized as dynamic, that is, which possess a certain potential of energy which may become actual at a subsequent time, or at least beyond the sphere of immediate observation. The inferred quality is as truly an element of certain knowledge as is the given attribute which bears to it the relation of the potential to the actual. A physician, for instance, prescribes a certain medicine, saying to the patient, "Take that, and it will induce a sound sleep, after which you will awake and will feel greatly refreshed." In this case the inference is merely the elaboration of the known properties of the medicine administered. The properties which are actually given may be such as taste, color, odor, specific gravity, or a characteristic chemical reaction; the inferred property, however, naturally lies beyond the sphere of direct observation, and yet is so inseparably connected with the given properties as to justify a procedure in thought from the one to the other.

In the three modes of inference as thus indicated, the inferred element is referred to a particular system because it is recognized as belonging to that system as its proper and peculiar place. It is seen to fit as a key into its lock. We have spoken of procedure in inference as being from the known to the unknown; it would be more accurate to describe it as a process which is a revelation of that which is contained within the known, and enveloped by it. In this respect it is an evolution of the given, rendering explicit that which is actually although implicitly present.

Now every judgment is the expression of a relation between subject and predicate in some known system of reality. Therefore, if that relation is properly evaluated in respect to its logical significance, the judgment in question is determined with a sufficient degree of precision to make it logically adaptable, *i. e*, in a state of readiness to be used as the basis for inference. The relations obtaining between subject and predicate in a judgment may have varying degrees of logical force, and consequently, will render possible several different kinds of inference according to our estimate of the logical value of these given relations. This variation in logical force may be observed in the following cases:

1. In the judgment, the predicate may bear a constant though not an exclusive relation to its subject, *i. e.*, the predicate may bear a similar relation to some other subject, or subjects. Thus the judgment that every insane person is to be considered legally irresponsible, indicates that legal irresponsibility is an inseparable attribute of the insane, but it does not preclude the possibility that legal irresponsibility may attach to other persons as well. The logical significance of the judgment is determined by such considerations as these.

2. The predicate may, however, bear a relation to its subject which is merely contingent, as in the following proposition: 'The Boers have been uniformly victorious in the recent engagements in South Africa.' Here the logical force is of such a nature as to warrant no inference as to the future. The uniformity observed in the past furnishes here no warrant for future prediction.

3. The predicate may bear to the subject a relation which is an exclusive one, consequently becoming a distinctive mark of the subject. This relation may be illustrated in every true defini-

tion, wherein the predicate term may be taken as the differentiating mark of the subject.

It will be seen, therefore, that every judgment has a certain logical weight according to the one or the other of these three classes to which it may be referred. Like a stone hewn for a definite place and purpose in a building, a judgment, through the process of a critical estimate as to its logical significance, is prepared for its appropriate purpose and place in the structure of knowledge.

It is to be noticed in passing that this evaluation of the logical force of a judgment is the work of induction. When completed, the inference when occasion offers becomes almost automatic. The real labor of inference, therefore, is performed in advance; for the judgment being assessed once for all at its proper value, the possibilities of valid inference which may be based upon it, are clearly defined, and adjust themselves to the various situations which may arise. These possibilities may be expressed in the following canons of inference:

1. When, in any judgment, the predicate is recognized as a constant property of the subject which may nevertheless be related to other subjects as well, the canon which is applicable to such a relation is as follows:

The subject being given, the predicate is necessarily implied; but the predicate being given, the subject is not necessarily implied.

In some cases, it may be well to remark, the predicate being given, a presumption may be created as to the presence of the subject in question, and may prove a guide concerning certain practical inferences which will have at best the force of a high probability merely.

The expression of this same canon in the case of negative judgments would be: The denial of the predicate negatives also the subject; but the denial of the subject does not necessarily negative the predicate.

2. When, in any judgment, the predicate is recognized as being merely an accidental mark of the subject, then no inference of a determinate nature is possible at all, unless further data be forthcoming.

3. When, in any judgment, the predicate is recognized as the differentiating mark of the subject, then the canon will run as follows: If either subject or predicate be affirmed or denied, a corresponding affirmation or denial of the other will follow as a necessary inference.

It will be noticed in the above that the variation in the logical force of our judgments will depend upon the different estimates we form as to the relation of predicate to subject in respect to the distinction between the terms property, accident, and *differentia*. Moreover, in reference to these canons and this mode of inference it is clear that if we should throw our data into syllogistic form, we should naturally adopt that of the hypothetical rather than that of the categorical syllogism.

The conclusion which has been reached as to practical procedure in inference, may be further illustrated by an inquiry concerning one of the most fertile sources of fallacy, namely, the failure properly to discriminate in our judgments as to whether the marks of a subject are distinctive in an exclusive and determinate sense, or not. Now, an error in this respect does not arise from faulty structure as regards the form of reasoning, but is one which is liable to occur in the process of thought at that particular stage when a judgment is in the making, and its value as basis for inference still undetermined. Thus, in paleontology, certain common features of structure have at times led to a false inference as to identity of species, because this parallelism was erroneously regarded as having the force of differentiating properties indicating one and the same species, when in reality it indicated certain common characteristics of two or more different species. Moreover, in order to determine in such cases the precise significance of marks which seem to have a differentiating function, it is necessary to frame some hypothesis as to the origin and history of the forms in question, and this will be found to complicate further the problem of inference, inasmuch as it introduces material considerations and inductive processes, and therefore renders more difficult a syllogistic form of expression.

The considerations which have been urged as to the practical canons of inference which provide a working method in our reasoning, have a pedagogical significance. There is danger that the student of logic may receive the impression that the formal exercises in connection with syllogistic criticism actually embrace the entire field of inference. Now, one of two results is likely to follow, if any undue emphasis is placed upon formal structure and formal criticism of the syllogism. Either the student will be perfectly satisfied with arguments of a sophistical nature, and will insensibly acquire the habit of substituting verbal for real distinctions, or, by a natural reaction he will regard the traditional syllogistic reasoning as an artificial mode of inference far removed from the real experiences of life, and consequently, he will come to have a distaste for the study of logic in general. Hence it is important to supplement the formal criticism of the syllogism by considerations suggested by an examination of the actual modes of reasoning in the practical experiences of life.

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